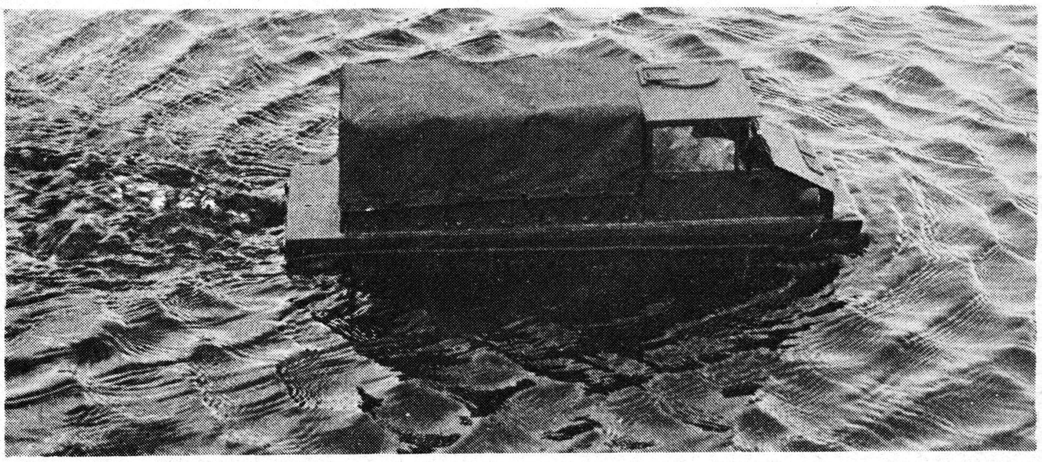


Geological SURVEY VEHICLE

build this exciting r/c amphibian

by MALCOLM SAUNDERS

I HAVE ALWAYS wanted to build an amphibian vehicle and, following a number of abortive attempts, started work on this model some two years ago. The track, suspension, gear-box and motor are a direct 'crib' from some local tank enthusiasts, so are well tried and tested. The general design, water drive and wiring layout are my own.

Early experiments with wheeled amphibians brought to light serious problems in obtaining traction during the transition stage between land and water. Rear wheel drive would drive into the water but would leave the drive wheels still afloat when the front wheels ran aground, on beaching. Front wheel drive was better but combining this with steering was beyond what I could manage on the kitchen table, so we could only go in straight lines!

It was some time later that I came across a happy band of ex-aero-modellers (who had lost their flying field), driving their 1in. scale tanks around the local common—and almost at once saw the possibilities.

The amphibian shown in the plans has a similar cross-country capability to a Centurion tank—the lower half of the hull closely resembling one, in fact. This means that the model is quite as happy climbing over books and cushions on the living room floor as it is trundling across the lawn and felling the flowers in the border! The vegetable patch and local sand quarry pose a real challenge, just like the North African sands must have been in WWII for our tanks. However, for real pleasure, you can't beat a drive round the footpaths on the common, with the occasional forage into the bracken—and a swim in the pond.

Speed in the water is little different from the land speed, although leaves and twigs can be a problem, just as they can with any ordinary model boat.

Development

The model did not work "straight off the drawing board," so to speak, considerable experimentation by myself and others having been necessary to obtain the results presented in this feature. Early experiments showed that plastic Meccano track would stretch rapidly at first but would then settle down and be surprisingly reliable. One must, however, be ruthless in the early breaking-in period, and replace any weak links—they tend to split across the hinge-pin hole, if you see what I mean. After half an hour's running or so, however, with link replacements as necessary, a good reliable track should result. The model pictured here is still using the original tracks after some twenty hours of operation—despite its weight of over 13lb.

The bogie suspension was found to be a good step forward in improving track reliability and climbing ability, but the bogies must not flex or the track will twist and break. 14 wheels are required, not counting the sprocket wheels, so an easy method of manufacture was needed. This was eventually arrived at by using a hole cutter (2¼in. dia.) from Woolworth's tool counter and, as

luck would have it, the pilot drill hole is just the right size to push the hub of a Meccano bush into, so giving the wheels metal bearings.

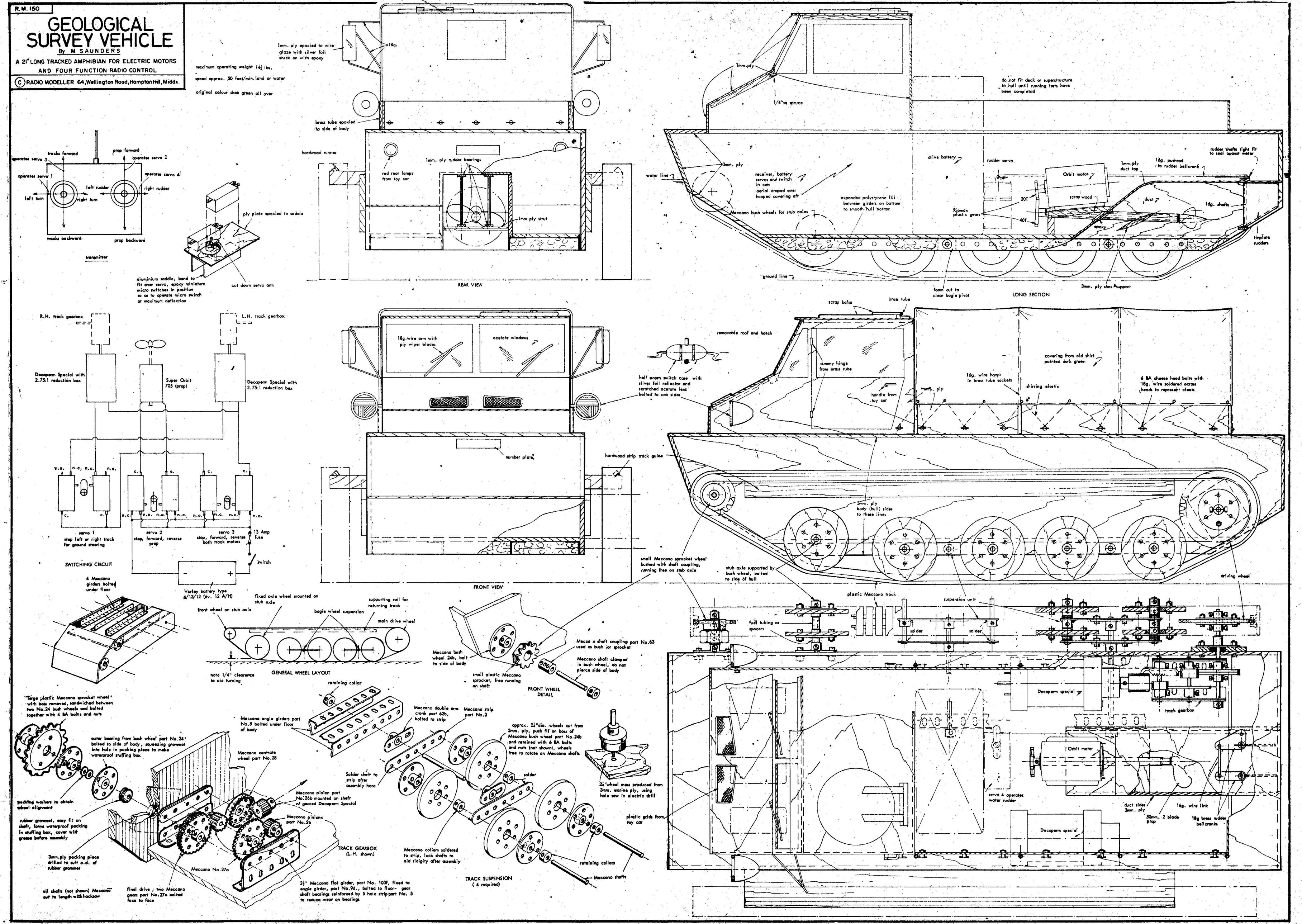
The main gearboxes caused a lot of trouble in the early days; worm wheel drive was tried but the thrust loads on the bearings were enormous. Early spur gearboxes suffered due to the gear wheels rotating around the centre bush. This was overcome, however, by soldering around the riveted area, and by doubling up the final gear drive, as shown. Headed screws were used instead of grubscrews, as they could be tightened more thoroughly, and double clamping screws are used wherever possible, to afford a better purchase on the drive shafts.

The bearing holes in the flat Meccano girder making up the sides of the gearbox were found to wear oval in time, due to the gear loads, and this was eventually overcome by reinforcing the bearing holes by the addition of a 5-hole strip.

Waterproofing the drive-shaft outlets is by means of sandwiching servo grommets on the shafts, between the hull wall and outer bearing bush wheels, well packed with grease before assembly. The main track sprocket drive is plastic Meccano with the plastic hub cut off and the sprocket bolted to a Meccano bush wheel. 6BA nuts and bolts were used, with hexagon nuts on the outside to give a realistic effect.

The motor which has been found most effective for driving the model is the 6v. Decaperm Special with reduction gearbox, as used in many electric-powered boats. The output shaft is "Meccano size," which greatly facilitates coupling to the gearbox in the model. The more powerful Hectoperm has been tried by the tank enthusiasts, but it was found that the additional power only caused transmission problems, with no improvement in climbing ability. Anyway, the Decaperm's power is adequate, since with an all-up weight not exceeding 14lb. the model will climb any gradient on which it can get traction.

Finally, the battery; current drain can be high (I've blown a 15amp fuse!) and the only battery we have found to be really suitable is the Varley 6v. 12aH as specified on the plan. Experiments with cheap 6v lead acid batteries showed an improved speed due to their being lighter, but they only lasted 5 to 8 minutes per charge. The Varley battery will give 1½ to 2 hours of continuous driving from one charge



R.M. 150

GEOLOGICAL SURVEY VEHICLE

By M SAUNDERS

A 21" LONG TRACKED AMPHIBIAN FOR ELECTRIC MOTORS AND FOUR FUNCTION RADIO CONTROL

ⓒ RADIO MODELLER 64, Wellington Road, Hampton Hill, Middx.

maximum operating weight 14½ lbs.

speed approx. 50 feet/min. land or water

original colour drab green all over

tracks forward
prop forward
operates servo 3
operates servo 2
operates servo 1
operates servo 4
left rudder
right rudder
left turn
right turn
tracks backward
prop backward
transmitter
ply plate epoxied to saddle
aluminium saddle, bend to fit over servo, epoxy miniature micro switches in position so as to operate micro switch at maximum deflection
cut down servo arm
1mm. ply epoxied to wire glaze with silver foil stuck on with epoxy
18g.
brass tube epoxied to side of body
hardwood runner
red rear lamps from toy car
1mm. ply rudder bearings
1mm ply strut
REAR VIEW
1mm.ply
1/4"sq spruce
do not fit deck or superstructure to hull until running tests have been completed
water line
3mm. ply
receiver, battery servos and switch in cab
aerial draped over hooped covering aft
expanded polystyrene fill between girders on bottom to smooth hull bottom
Meccano bush wheels for stub axles
drive battery
rudder servo
Ripmax plastic gears
20T
40T
Orbit motor
scrap wood
1mm.ply duct top
16g. pushrod to rudder bellcrank
rudder shafts tight fit to seal against water
duct
epoxy
16g. shafts
tinplate rudders
ground line
foam cut to clear bogie pivot
3mm. ply shaft support
LONG SECTION
R.H. track gearbox
L.H. track gearbox
Decaperm Special with 2.75:1 reduction box
Super Orbit 705 (prop)
Decaperm Special with 2.75:1 reduction box
n.o.
n.c.
n.c.
n.o.
c.
c.
c.
c.
c.
c.
n.c.
n.o.
n.o.
n.c.
n.o.
n.c.
n.c.
n.o.
servo 1 stop left or right track for ground steering
servo 2 stop, forward, reverse prop
servo 3 stop, forward, reverse both track motors
13 Amp fuse
switch
SWITCHING CIRCUIT
Varley battery type 6/13/12 (6v. 12 A/H)
18g. wire arm with ply wiper blades
acetate windows
half acorn switch case with silver foil reflector and scratched acetate lens bolted to cab sides
number plate
hardwood strip track guide
FRONT VIEW
scrap balsa
brass tube
removable roof and hatch
dummy hinge from brass tube
handle from toy car
1mm. ply
16g. wire hoops in brass tube sockets
shirring elastic
covering from old shirt painted dark green
6 BA cheese head bolts with 18g. wire soldered across heads to represent cleats
3mm. ply body (hull) sides to these lines
small Meccano sprocket wheel bushed with shaft coupling, running free on stub axle
stub axle supported by bush wheel, bolted to side of hull
driving wheel
plastic Meccano track
suspension unit
fuel tubing as spacers
solder
solder
Decaperm special
track gearbox
Orbit motor
servo 4 operates water rudder
duct sides 3mm. ply
50mm. 2 blade prop
16g. wire link
18g brass rudder bellcranks
Decaperm special
plastic grids from toy car
4 Meccano girders bolted under floor
fixed axle wheel mounted on stub axle
front wheel on stub axle
bogie wheel suspension
supporting rail for returning track
main drive wheel
note 1/4" clearance to aid turning
GENERAL WHEEL LAYOUT
Meccano bush wheel 24b, bolt to side of body
small plastic Meccano sprocket, free running on shaft
Meccano shaft coupling part No.63 used as bush for sprocket
Meccano shaft clamped in bush wheel, do not pierce side of body
FRONT WHEEL DETAIL
large plastic Meccano sprocket wheel with boss removed, sandwiched between two No.24 bush wheels and bolted together with 4 BA bolts and nuts
outer bearing from bush wheel part No.24 bolted to side of body, squeezing grommet into hole in packing piece to make waterproof stuffing box
packing washers to obtain wheel alignment
rubber grommet, easy fit on shaft, forms waterproof packing in stuffing box, cover with grease before assembly
3mm.ply packing piece drilled to suit o.d. of rubber grommet
all shafts (not shown) Meccano cut to length with hacksaw
final drive; two Meccano gears part No.27a bolted face to face
Meccano No.27a
Meccano contrate wheel part No.28
Meccano pinion part No.26b mounted on shaft of geared Decaperm Special
Meccano pinions part No.26
TRACK GEARBOX (L.H. shown)
2½" Meccano flat girder, part No. 103f, fixed to angle girder, part No.9d., bolted to floor- gear shaft bearings reinforced by 5 hole strip part No. 5 to reduce wear on bearings
Meccano angle girders part No.8 bolted under floor of body
retaining collar
Solder shaft to strip after assembly here
Meccano double arm crank part 62b, bolted to strip
Meccano strip part No.3
approx. 2½"dia. wheels cut from 3mm. ply, push fit on boss of Meccano bush wheel part No.24b and retained with 6 BA bolts and nuts (not shown), wheels free to rotate on Meccano shafts
solder
Meccano collars soldered to strip, lock shafts to aid ridigity after assembly
retaining collars
Meccano shafts
TRACK SUSPENSION (4 required)
2½"wheel mass produced from 3mm. marine ply, using hole saw in electric drill

★ **FULL SIZE PLANS** PRICE £1.25 plus postage* from RADIO MODELLER PLANS DEPT., 64 WELLINGTON ROAD, HAMPTON HILL, MIDDX., TW12 1JT ★

(*See handy order form on page 67)

(for which one can use the car battery charger).

Steering

On this model, the steering is effected by switching off the motor on the inside of the turn. For large radius turns or for minor course corrections, the motors are switched off-on, off-on in pulse fashion, thus effectively slowing one motor without actually stopping it. The ratio of track length in contact with the ground, to distance between track has been kept deliberately to about 1 : 1. If the tracks are set too close together, the outer track is unable to secure enough leverage, in a turn, to skid the body round while, if they are too far apart, it becomes almost impossible to steer a straight line. Full-size practice is to have a length-to-distance-apart ratio of between 1.1 : 1 and 7 : 1.

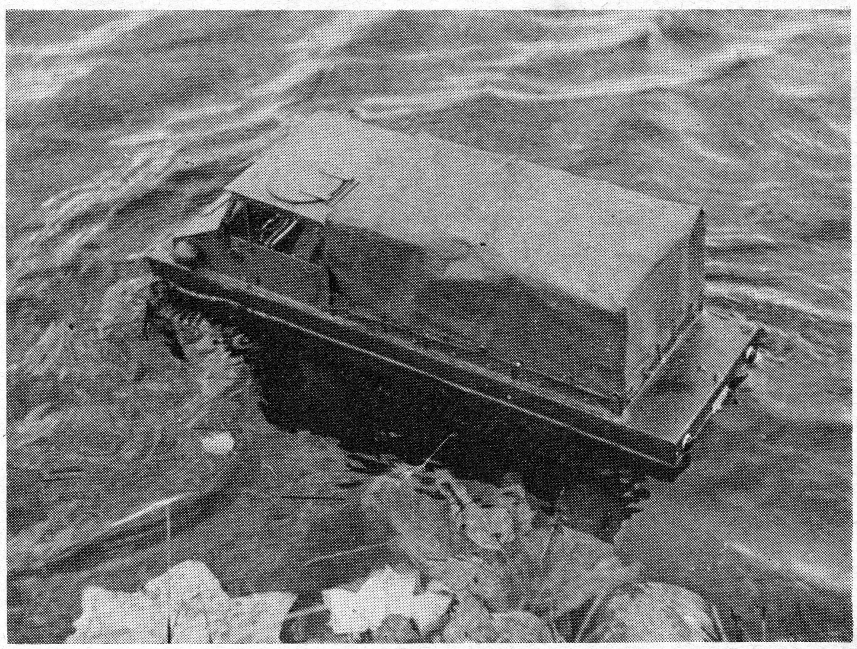
It was to obtain the low ratio that we raised the front large wheels $\frac{1}{4}$in. above the bogie pivot centres. This has the effect of giving a low ratio on smooth ground where contact and skid resistance to steering is high, while over rough ground the bogies rotate and allow the front wheels to make contact with the ground, thus giving a higher track length-width ratio with consequently better directional stability.

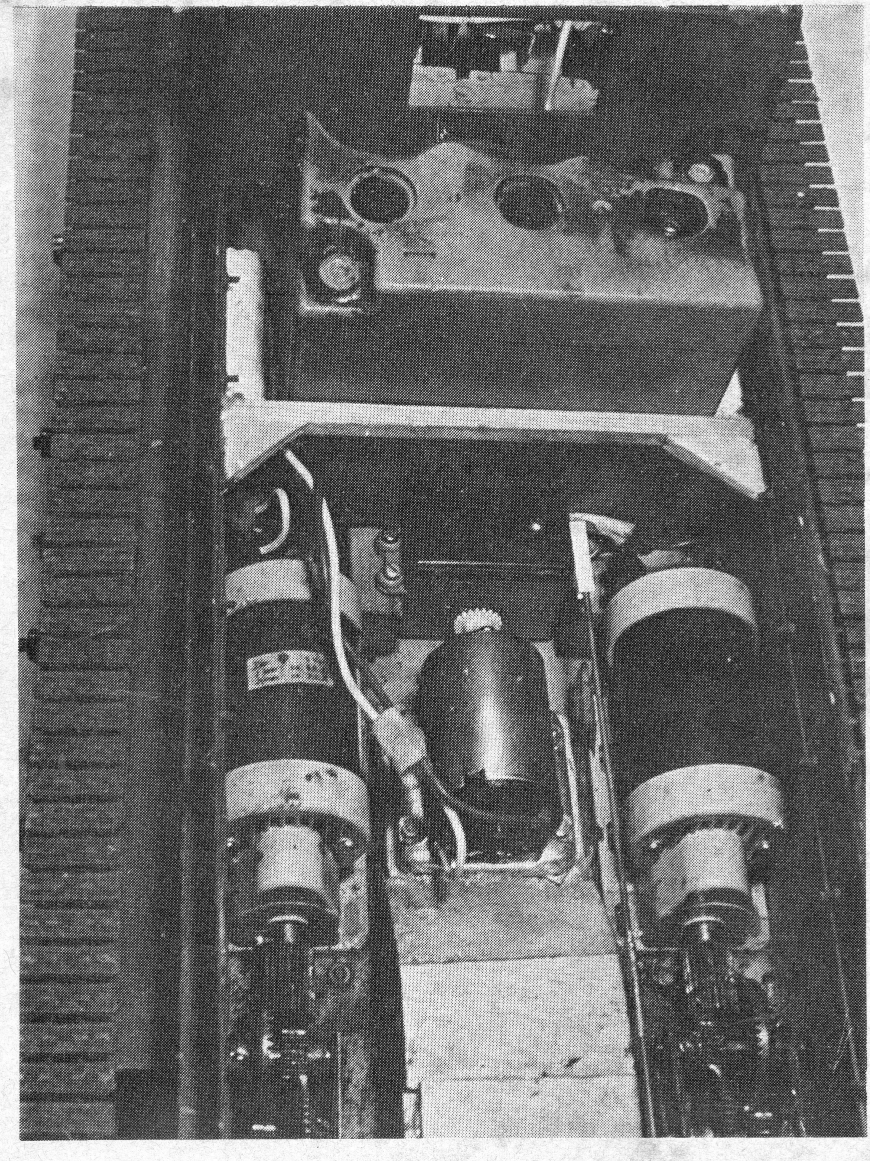
This raised front axle has given additional unforeseen advantages in that, when running onto the rising ground after a swim, the slight lift of the track at the front offers a better contact to pull the model ashore.

Water drive

This was not without its problems. One of the design specifications I set myself was that the propeller and water rudder must be within the outline of the hull, so that cross-country ability would not be affected and the propeller and rudder well protected. This meant putting the propeller and rudder in a tunnel or, more accurately, an inverted 'U' channel, in the bottom of the body. First attempts were with a Kitchen type rudder, giving a kind of ducted thrust effect—or that was the idea. In practice, the steering effect was nil!

The rudder assembly was therefore replaced by a conventional one, of the boat type, but, when this was tried, the steering effect was still conspicuously absent. The conclusion was finally reached that, because the rudder was completely operating in the tunnel, the deflected water must be hitting the tunnel wall





These shots show clearly the installation of battery and the three motors—two for ground and one for water drive.

and bouncing back, cancelling the rudder deflection. To overcome this, the rudder assembly was again modified to a twin rudder set-up, as shown on the plan, (see rear view). The idea behind this was to shut off one third of the water flow on one side of the tunnel when turning, and effectively to direct the middle third in the direction required by guiding it between the two rudders. This should be clear from the diagram.

Back at the pond the change was dramatic, with positive steering down to a minimum radius of about 6ft. Speed in the water was, however, disappointing, and it took a change to a larger propeller and a different 'Z'-drive gear ratio to attain a water speed comparable with the land speed. Incidentally, I use a 2 : 1 or 3 : 1 gear reduction on all my electric powered boats as I find it gives improved performance and overcomes any slight misalignment at one and the same time.

CONSTRUCTION NOTES

The body is all from plywood, starting with the floor and bolting on the 10in. girders which mount the bogie axles. The sides and ends are then fitted, and it is best to install the motors, gearboxes and ensure that everything is working properly before fitting the top deck and superstructure. Shirring elastic is used to hold the soft top on, the cover itself being an old shirt (!) painted with enamel.

Make sure that the battery is firmly located, so that it will not move when the model is travelling over rough ground—or you may find it has an awful list to one side when it goes afloat. On the original, changeover contacts were built up from scrap contact-breaker blades epoxied to an aluminium saddle which sat on each of the servos. On the wiring diagram I have shown miniature micro switches, which can be positioned carefully and epoxied to the aluminium saddle. Several tank club members use micro switches and have found that they stand up to the switching required of them.

Controls and running

I set up my radio with the track drive on the left, as shown in the sketch. The functions are: (1) *Forward,* both motors forward. (2) *Centre,* stop both, (3) *Back,* reverse both. (4) *Left,* left motor stops. (5) *Right,* right motor stops.

On the right hand stick I have: (1) *Forward,* forward propulsion on the water propeller. (2) *Centre,* stop water propeller. (3) *Back,* reverse thrust on water propeller. (4) *Left,* left turn on water rudder. (5) *Right,* right turn on water rudder.

The usual routine is to check the tracks for worn links before setting out for a run, but make sure you have some spare ones in the drive cab too, just in case. When you reach the operating site, switch on the model and the radio and drive it down to the water. When turning on grass it will be found better to 'pulse' a turn, rather than stop one motor and skid round. On entering the water, start up the water prop and, when well afloat, stop the tracks. On approaching the shore, start up the tracks again and the model should come smoothly out of the water, making a nice even transition. The tracks have very little propelling effect in the water, by the way, so no advantage is gained from running them while afloat.

If you want something different, in which to run your radio outfit, and a real crowd drawer—here it is. Send for a plan today!